



Ground Water Protection in Virginia

Thirteenth Annual Report of the Ground Water Protection Steering Committee

Ancient Blast from Space Leaves Lasting "Impact" on Eastern Virginia's Ground Water

About 35 million years ago, a mile-wide meteor or comet struck the earth near the present-day mouth of Chesapeake Bay. Sea level was higher than today, so most of eastern Virginia was submerged beneath the ocean. In an instant, the object sliced through the water and thousands of feet of underlying sediment, colliding violently with continental bedrock several miles beneath the surface. The surrounding region was soon engulfed in widespread devastation. Within minutes, many millions of tons of water, sediment, and shattered rock were cast high into the atmosphere for hundreds of miles along the coast. An enormous seismic sea wave—or tsu-

nami—rushed westward, engulfing the land and possibly even overtopping the Blue Ridge Mountains. At the point of impact, a crater more than 50 miles wide was formed (see figure). The crater began immediately to rush back inward with a chaotic mix of water, sediment, debris—and remains of the many millions of animals and plants killed by the blast.

Evidence of these startling events has been found by David S. Powars and C. Wylie Poag of the U.S. Geological Survey and T. Scott Bruce of the Virginia Department of Environmental Quality (see page 3). Earlier this year, these scientists received the Thomas Jefferson Award from the Vir-

ginia Museum of Natural History in recognition of their discovery of the Chesapeake Bay Impact Crater. They and their colleagues have been conducting research drilling and other studies across the region for the past several years. These efforts have gradually revealed a picture of the catastrophe which befell eastern Virginia one day near the end of the Eocene period—ancient by human standards but relatively recent compared to the over four-and-a-half billion-year history of the earth.

Although partly filled in quickly, the crater left a deep depression beneath the ocean. Fine-grained sediments then slowly settled into the crater over many thousands

Continued on page 15

TABLE OF CONTENTS

I. PERSPECTIVE

- Ground Water Protection Steering Committee 99-00 Activities 1

II. ACTIVITIES AND SERVICES

- Blast leaves "Impact" on Virginia's Ground Water 1
- Local Ground Water Committees in Action 2
- Va.'s Aquifer Susceptibility Study .. 2
- Ground Water Scientists Recognized for Contributions 3
- Virginia Rural Water Association: GW Protection Programs 4
- Virginia Naturally 2000 4
- Children's Ground Water Festival Planned 4
- Va.'s NPS Management Program . 5
- Cat Point Creek 6
- Multimedia CD-ROM Series "Geology of Virginia" 6

- Virginia Beach Ground Water Assessment 7
- Legislation for Public Water Supply Testing for MTBE 7
- MTBE - Did you Know? 7
- VA Agricultural Stewardship Act ... 8
- 1999 Virginia Plastic Pesticide Container Recycling Program 10
- 1999 Virginia Pesticide Disposal Program 12
- VCE - Irrigation Management Education Program 13
- Better Site Design and the Chesapeake Bay Preservation Act 14

III. INFORMATION

- GWPSC Meeting Dates 3
- Overview of Agency Functions 5
- GWPSC Website 15
- Publications 16

I. PERSPECTIVE

Ground Water Protection Steering Committee 1999-2000

The Ground Water Protection Steering Committee's 14th year saw two significant changes in personnel. Two members who had been active since the inception of the Steering Committee resigned from state government during 2000. Ed Lefebvre, with the Division of Consolidated Laboratory Services, and Rick Bartsch, of the Department of Health, each took some time to reflect upon their experiences with the Steering Committee, which began with the development of the Commonwealth's first Ground Water Protection Strategy in 1987.

Improvements have been made in ground water protection, including well-head protection programs and the new source water assessment program. But there remains much to be done to ensure ground water protection. Among other needs are basic research about the location and movement of water in aquifers,

Continued on page 11

II. ACTIVITIES AND SERVICES

Local Ground Water Committees in Action

As with many environmental issues, ground water protection concerns vary depending on the real and perceived importance of ground water in local areas. In many areas of the Commonwealth, ground water serves as the sole source of potable water for public and private domestic uses. In other areas, ground water is utilized as the source of water for large industrial uses that support the socio-economic structure of the region. In addition, ground water occurrence and vulnerability to contamination and over-utilization vary across the five physiographic provinces of the Commonwealth.

These distinct local concerns have been addressed in some areas of the Commonwealth by the establishment of local ground water protection committees. There are longstanding local ground water committees on the Eastern Shore (Eastern Shore of Virginia Ground Water Committee) and

in the Hampton Roads area (Hampton Roads Planning District Public Utilities Director's Committee). More recently, local ground water committees have been established in the Middle Peninsula and Northern Neck.

Membership on these local committees varies depending on the particular ground water concerns of the area. Typically membership includes local elected representatives (such as members of the Board of Supervisors), county administrators, representatives from the water well industry, representatives from local health departments, and interested private citizens. In each of the examples listed above, the Planning District Commission has been the basis for determining the area of concern and PDC staff provide support to the ground water committees.

These local committees serve several valuable roles in protecting the ground

water resources of the Commonwealth. First and foremost, they serve as a mechanism to formalize local concerns regarding ground water. They can serve a valuable role in educating the public regarding ground water issues important to the area and obtaining a broad base of support to address those issues. They can serve as a mechanism to obtain funding to complete ground water protection projects important to the area. They also can serve as a very effective mechanism for raising ground water protection issues to elected representatives who have the ability to assure that programs are properly funded to address those issues.

As an example, the Eastern Shore of Virginia Ground Water Committee successfully lobbied their representatives to the Virginia General Assembly to provide a special appropriation to develop a ground water management plan for the Eastern

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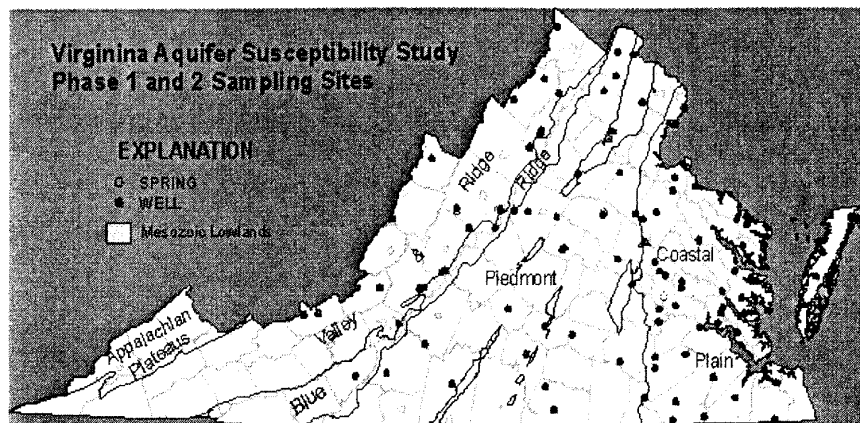
Virginia Aquifer Susceptibility Study: Dating of Ground Water for Source Water Assessment Screening

The U.S. Geological Survey (USGS), in cooperation with the Virginia Department of Health (VDH), has developed the Virginia Aquifer Susceptibility (VAS) Study in support of the Commonwealth's Source Water Assessment Program (SWAP). The VAS study will use atmospheric tracers (such as chlorofluorocarbons, tritium, and carbon-14) that are commonly present in ground water to determine "apparent age," which is the time since the water containing these tracers was isolated from the atmosphere. The apparent age of ground water provides information about the flow of water within an aquifer and the susceptibility of a water supply to near-surface contamination. The fundamental premise of the VAS study is to use age determinations as a guide for the classification of areas in terms of the susceptibility of ground water to near-surface contamination. A young apparent age (< 50 years)

indicates greater susceptibility to near-surface contamination since relatively little time has passed to allow for attenuation of contaminants in the subsurface, and because many regulated chemicals have been introduced into the environment in large quantities since the mid 1940s, following World War II.

The water that recharges an aquifer car-

ries the chemical signature of the atmosphere from which it was derived. Atmospheric concentrations of such constituents as chlorofluorocarbons (CFCs) and tritium (^3H) have changed over time. Because it can be assumed that infiltrating water is in equilibrium with the atmosphere, the concentrations of these constituents in ground water reflect their atmospheric concentra-



tions at the time the water was isolated from the atmosphere. The environmental tracers and isotopes present in a ground-water sample were derived from the atmosphere at the time of recharge. Sample collection and analytical methods must minimize or eliminate contact of the sample water with the atmosphere at the time the sample is collected. The environmental tracers and isotopes used for age determinations are listed in table 1.

The Safe Drinking Water Act Amendments of 1996 were enacted to ensure that the United States has safe drinking water and that communities are prepared to address water-supply contamination where it occurs. The U.S. Environmental Protection Agency is charged with implementing the Amendments and has mandated that each state must develop a SWAP to identify source areas of public drinking water, assess the susceptibility of public supplies to contamination, and make this information available to citizens. The Office of Water Programs, VDH is coordinating the SWAP for the Commonwealth of Virginia. Time and cost considerations prohibit a detailed assessment of each of the more than 4,000 public water supplies in Virginia. Thus the VAS study proposes to characterize the susceptibility of all of the regional aquifers by studying a representative sample of water-supply wells. Over the

Environmental isotope/tracer	Age Range (years)	Laboratory
Chlorofluorocarbons (CFC-11, CFC-12, and CFC-113)	0 to 50	USGS, National Research Program Reston Chlorofluorocarbon Lab, VA
Tritium	0 to 50	USGS, National Research Program Menlo Park, CA
Tritium/Helium-3	0 to 30	Lamont-Doherty Earth Observatory Columbia University, NY
Carbon-14	1,000 to 30,000	Univ. of Waterloo, Canada Rafter Radiocarbon Laboratory Institute of Geological & Nuclear Sciences, Ltd., New Zealand

Table 1.

four-year term of the VAS, approximately 160 public supply wells will be sampled across Virginia. The results of the study will be used to screen community water supplies and focus detailed source water assessments where they are most needed.

Over the past two years 110 wells and springs have been sampled in the Coastal Plain, Piedmont, Blue Ridge, and Valley and Ridge Physiographic Provinces of Virginia (fig. 1). The final phase of sampling in the Appalachian Plateaus Physiographic Province will be completed in the summer of 2000. Data analysis and report writing will be completed in the summer of 2001.

EPA approved the Source Water Assessment Program (SWAP) in November 1999. VDH began the inventorying of Land Use Activities (LUAs) in May of this year. The SWAP pertains to both surface and ground water. Final completion of the program will be May 2003. Information gathered from the USGS Aquifer Age Dating Study will be used to determine sensitivity of aquifers.

Ground Water Scientists Recognized for Outstanding Contributions

The Virginia Museum of Natural History Foundation annually awards the Thomas Jefferson Medal for Outstanding Contributions to Natural Science. On February 1, 2000 this prestigious award was presented to three scientists for their research in the Virginia Coastal Plain. T. Scott Bruce, Virginia Department of Environmental Quality; C. Wylie Poag, United States Geologic Survey (USGS), Woods Hole Oceanographic Institution; and David S. Powars, USGS, Water Resources Division received this honor for their research on the Chesapeake Bay Impact Crater (CBIC) that drastically changed the landscape of Virginia some 35 million years ago.

This meteor impact that formed an enormous crater is considered to be the most dramatic geological event that ever took place in the Chesapeake Bay region. The crater is estimated to be twice the size of Rhode Island and nearly as deep as the Grand Canyon. The work by Bruce, Poag, and Powers considerably changes the assumptions regarding ground water occurrence in the Virginia Coastal Plain and has significant implications regarding management of ground water withdrawals in the region. This discovery represents a unique opportunity for scientists to study the structure related to a large meteor impact.

The United States Geologic Survey, Geologic Division, has initiated a four to five year study to determine the location of the outer rim of the impact crater. Four to five geologic cores will be collected to delineate the likely location of the crater rim. These geologic cores will be analyzed for various properties and will be supplemented with a series of seismic profiles to better define the geometry of the impact

Continued on page 16

The Ground Water Protection Steering Committee Meeting is held the third Tuesday of every other month

(January--March--May--July--September--November)

Feel Free to Attend

Meetings are normally held at the Dept. of Environmental Quality, 629 E. Main St., Richmond, from 9 a.m. to noon.

For more information, contact Mary Ann Massie, DEQ, at 804-698-4042

Virginia Rural Water Association: Ground Water and Source Water Protection Programs

The Virginia Rural Water Association (VRWA) is an affiliate state of the National Rural Water Association. VRWA incorporated in Virginia in 1987 as a non-profit 501(c)(3) corporation. At present, some 235 utilities statewide are members of VRWA, as are 133 businesses and 67 individuals. VRWA's primary purpose is to provide training and educational opportunities and on-site technical assistance to water and wastewater utilities statewide. On-site technical assistance is provided by an increasing number of programs ranging from Water Circuit Rider to a Management Support Technician. Approximately 30% of VRWA's resources are devoted to the protection of public drinking water sources and supplies.

Ken Coffman, Ground Water Technician, provides technical assistance to establish ground water protection plans for community public water systems. He also conducts formal and informal training sessions throughout the state. Close ties are kept with Federal and State agencies to further these efforts. Coffman has also served on several statewide and local committees and teams involved in developing guidance and tools to aid systems in developing protection programs.

The Source Water Protection program has been in place since August 1998. This program is based on the Virginia Department of Health-Office of Water Programs (VDH-OWP) Source Water Assessment Program and funded through a contract with VDH-OWP. Steve Childers currently serves as Source Water Technician. The main goal of this program is to provide education on the issues of source water protection and assist both ground and surface water systems in implementing and developing source water protection programs. In the first two years, 230 different systems were contacted and provided information about the program. 378 on-site visits were made to these systems and

4,088.75 program hours worked.

Currently, VRWA is helping many individual systems throughout the state implement and develop source water protection programs. VRWA is also working with the counties of Page, Shenandoah, Lunenburg, King George and Charlotte to establish and implement viable source water protection plans at a county level. Three of these counties have both surface water and ground water sources for their drinking water supplies.

The technical assistance rendered to these localities is predicated toward the concept of them assuming ownership and responsibility for the plans developed. The establishment of partnerships between the Counties, Towns, other public water supplies, State Agencies, and assisting entities such as VRWA is stressed in the development of these plans. Making use of the data, information, and sample plans available to the localities is also a major part of these efforts.

VRWA has been on the web since September 1998. The web site is updated daily. The site now includes an updated calendar that lists all current and scheduled future training being conducted by VRWA and online registration for these activities. The site also has two new sections devoted to the ground water and source water protection programs. These sections provide information and links to other sites to assist communities in developing protection programs. Check them out to find more about our association and the services we provide.

To contact VRWA:

Phone: 540/261-7178

Fax: 540/261-2465

E-Mail: cmdrbrown@rockbridge.net

Web: <http://www.vrwa.org/>

For more information about these activities:

Ken Coffman-Ground Water Technician

Home: 540/992-5967

Fax: 540/992-5267

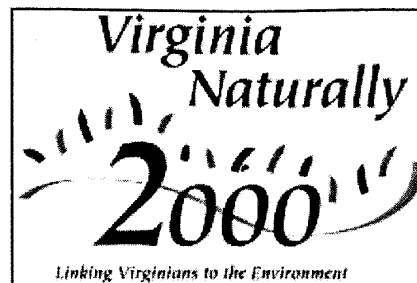
E-Mail: kcoffman42@mindspring.com

Steve Childers-Source Water Technician

Home: 804/696-2884

Fax: 804/696-4079

E-Mail: schilders62@yahoo.com



In this year's State of the Commonwealth address, Governor James S. Gilmore, III unveiled a new statewide environmental education initiative called Virginia Naturally 2000. This cutting-edge effort to promote lifelong learning about Virginia's environment is designed to foster responsible stewardship in all Virginians, young and old, in order to protect the Commonwealth's unmatched bounty of natural and historic resources.

The centerpiece of Virginia Naturally 2000 is its website, located at www.VaNaturally.com. The website, a virtual library, is your gateway to a world of learning about Virginia's environmental education resources. It can take you to fascinating places, connect you to recreational activities, community events and lesson plans, or get you involved in fulfilling volunteer opportunities. You can choose from a myriad of programs, publications, classes and events for adults and young people.

Virginia Naturally 2000 is made possible by a unique public-private partnership. Your support, whether volunteer or financial, is encouraged. To become a Virginia Naturally 2000 partner, please call: 1-800-592-5482, or email vanaturally@deq.state.va.us or log on to www.VaNaturally.com.

2000 Children's Ground Water Festival

Four hundred sixth grade students and their teachers from J. Frank Hillyard and Elkton Middle Schools in Rockingham County will attend a ground water festival on September 22, 2000. The event will be held at Massanutta Springs Conference Center in Harrisonburg and coincides with

National Water Education Day. The Festival is sponsored by Virginia DEQ, the Ground Water Protection Steering Committee (GWPSC), National Project WET, Perrier Spring Water, and USEPA. The Festival will also be supported by Project Underground and the Karst Project from the Department of Conservation and Recreation. Personnel from agencies represented on the GWPSC as well as a host of volunteers associated with Shenandoah Pure Water 2000 will be on hand to lead programs, escort, and chaperone.

The teachers will receive one day of training in August to prepare for the September festival. In addition, workbooks will be provided to the teachers to link festival sessions to Virginia Standards of Learning (SOLs). Students will also receive a packet the day of the festival. Teachers and students will become familiar with ground water protection issues ranging from impacts of non-point source pollution on ground water to the sensitivity of karst geology and springs.

The Festival is a "Virginia Naturally 2000" event. For more information on the festival visit the GWPSC web page at deq.state.va.us/gwpsc.



Virginia Nonpoint Source Pollution Management Program

In January 2000, the Environmental Protection Agency (EPA) approved the Commonwealth of Virginia's upgraded Nonpoint Source (NPS) Pollution Management Program. This was the culmination of a year filled with interagency work group meetings, discussions, draft documents and many revisions! The program addresses the nine key elements outlined in EPA's management program guidelines.

EPA lauded Virginia's program document as being "extremely specific and clear, affording any potential partners or citizens an easy understanding of the state's program and their place within it." Regional EPA staff state that Virginia's NPS Pollution Management Program can serve as a model for states in Region III and elsewhere in the United States.

Virginia's program contains a detailed set of clear, long-term goals, including:

- maintain existing beneficial uses in unimpaired state waters and restore beneficial uses in impaired surface waters, as listed under Section 303(d), and ground waters, based on state ground water standards by 2014 for confined animal feeding operations and livestock grazing;
- a similar goal for cropland and nursery management;
- reduce nutrient and sediment pollution entering Virginia's waters from silvicultural activities by maintaining reduced levels of all nonpoint source pollutants to sustain designated uses and achieve beneficial uses of waters of the commonwealth by 2015; and
- implement erosion and sediment control on construction sites in accordance with Virginia's Erosion and Sediment Control and Stormwater Management regulations.

Since approval, work groups have convened to discuss strategy for effective implementation of the goals set forth in the NPS Pollution Management Program. The state agency designated as lead for

each goal will evaluate its program and establish a feedback loop to ensure that the state accomplishes its objectives. Ground water management is addressed in the context of each source, i.e., agriculture, urban, forestry, etc., that contributes to nonpoint source pollution.

The Nonpoint Source Pollution Management Program will be evaluated and updated every five years. The Virginia Nonpoint Source Advisory Committee (NPSAC), an inter-agency group, will continue to play an important role in program implementation and evaluation.

Questions regarding the management program or requests for copies of the document should be directed to Rick Hill with the Department of Conservation and Recreation at (804)786-7119. A digital copy will be available at the DCR web site at: <http://www.state.va.us/~dcr/dcrhome.htm>

Overview of Steering Committee Ground Water Functions

The Virginia Department of Agriculture and Consumer Services (VDACS) administers the Commonwealth's pesticide programs, which are designed to prevent ground and surface water contamination by pesticides and to promote good stewardship in relation to the use and disposal of pesticide products. VDACS is also the home of the Agricultural Stewardship Act program, which helps correct farming practices and conditions that are causing or will cause ground or surface water pollution and which promotes good stewardship of the land generally. (Web site: <http://www.state.va.us/~vdacs/vdacs.htm>) Contact: Sara Pugh, 804-786-3539

The Chesapeake Bay Local Assistance Department (CBLAD) addresses ground water protection in several ways. First, the Bay Act Regulations include provisions pertaining to septic system maintenance, with the goal of reducing and preventing system failures

Continued on page 9

The Cat Point Creek Experience

Chesapeake Bay Restoration through a Small Watershed Initiative

The Cat Point Creek watershed covers some 73 square miles of coastal plain lands in Richmond and Westmoreland Counties, Virginia, with a population of about 3,200. The watershed contains 65 percent forestland and 25 percent farmland, with farm size averaging about 315 acres. Timber harvesting averages about 2,000 acres annually, putting the watershed in the top 20 percent of all Virginia watersheds for forestry activity. Private ownership, steep slopes, and marsh and swamp lands limit public access to the Creek's 23-mile course. However, the road network in the watershed is well developed.

More than a decade ago the Richmond County Board of Supervisors designated the Cat Point Creek area a "scenic, pristine and unique area to be protected." The State also identified the watershed as having significant non-point source pollution potential, owing to land use and sensitive physical features, including highly erosive and leachable soils. That potential and the agricultural loading of nutrients and silvicultural activity in the area made the watershed a high priority area for non-point source pollution abatement.

The Tidewater Resource Conservation and Development Council (TRC&D) initiated on-the-ground activity in 1995 to measure various parameters of stream and ground water, and to conduct field-oriented workshops and demonstrations about agricultural and forestry Best Management Practices. Early water quality monitoring and testing revealed that nutrient enrichment was occurring in the middle and lower portions of the watershed. A key question became "could the use of certain Best Management Practices, and specifically Integrated Crop Management (ICM), help to reverse this situation?"

The Cat Point Creek project has been financed by grants from EPA through the Virginia Department of Conservation and Recreation and the Virginia Department of Environmental Quality. About half of the project work has been devoted to recruiting and working with farm producers to

implement ICM and to track and quantify the resultant effects on ground water quality of nitrogen and phosphorus. Some 611 demonstration acres have been put under Memoranda of Agreements for ICM, and nearly four years of ground water data collected for nutrient analyses from four well sites, two ICM sites and two adjacent control sites. Sampling will continue at least through December 2000.

Preliminary analysis of ground water samples collected early in the project shows less nutrient leaching under ICM fields than under control fields. Detailed analysis of these and subsequent observations will be done after December 2000 to determine the long-term effects. Control fields are cropped under conventional or traditional farming practices. ICM fields are cropped under conservation practices, e.g., soil and plant tissue testing, conservation tillage, split nitrogen regime, and intensive field scouting for weeds, disease and insects. The message that producers in the program have learned is to apply fertilizer and chemicals only to the extent the crop needs it. Most producers in the project feel that ICM practices have saved them money, improved crop yields and reduced the potential for erosion and sedimentation from their fields. Hopefully, TRC&D is getting some hard answers that Integrated Crop Management in the Cat Point Creek watershed is affecting ground water quality in positive ways. If so, the Chesapeake Bay will be the beneficiary. For more information, contact Larry Hill, Watershed Coordinator, Tidewater RC&D 804-443-1118.

Spread the Word!!

Do you know of an individual or organization who would benefit from receiving a copy of this and future Annual Ground Water Reports?

Call Mary Ann Massie at (804) 698-4042 to add names to the mailing list.

Multimedia CD-ROM series "Geology of Virginia"

The Department of Mines, Minerals, and Energy (DMME), Division of Mineral Resources and Radford University continue work on the development of an interactive, multimedia CD-ROM series entitled the "Geology of Virginia." The first and second CDs in the series, an introduction to Virginia Geology and the Virginia Coastal Plain, have been completed. The *Introduction to Virginia Geology* CD, a companion teacher's guide, and student exercises have been distributed free of charge to every high school in the Commonwealth. In addition, the Virginia Aggregates Association along with its member companies intends to distribute the five CD set and resource materials to all ninth grade classrooms throughout the Commonwealth. Three additional CDs, teacher's guides and student exercises that are specific to the Blue Ridge, Piedmont, Valley and Ridge, and Cumberland Plateau physiographic provinces will be produced by June 2001.

This project is a private-public partnership to provide educational materials to support high school teachers with Virginia's Standards of Learning. Partners include the Department of Mines, Minerals, and Energy, the Department of Environmental Quality, Chesapeake Bay Local Assistance Department, US Geological Survey, Virginia Department of Education, Charles W. Barger and Son Construction Company, Inc., Boxley Company, Inc., Carter Machinery Company, Inc., E. Dillon and Company, Kyanite Mining Corporation, Luck Stone Corporation, Martin Marietta Aggregates, Rockydale Quarries Corporation, Salem Stone Corporation, Tarmac America, Inc., Tidewater Quarries, Inc., U.S. Silica, Virginia Aggregate Association, and Vulcan Materials Company. For more information about this project contact Stan Johnson at DMME, 804-951-6350.

Virginia Beach Ground Water Assessment

To ensure a reliable supply of fresh ground water, the City of Virginia Beach Public Utilities Department, in cooperation with the U.S. Geological Survey (USGS), began an assessment of the shallow ground water resources underlying the City of Virginia Beach. The USGS is working to refine the hydrogeologic framework and assess the hydrogeologic characteristics, ground water flow, and water quality of the shallow aquifer system. The study will provide a better understanding of the distribution of fresh ground water, its potential for development, and its susceptibility to contamination. The study will also establish baseline conditions for summer low water levels through a network of monitoring wells.

Over the past year, the study has progressed on several fronts. In June 1999, small-diameter core samples were obtained at 24 sites across the City of Virginia Beach to provide reconnaissance hydrogeologic information in preparation for well drilling (Figure 1). In August, synoptic water level and specific conduc-

tance measurements were collected from 39 observation wells (Figure 1). In April and May 2000, 10 observation wells were installed at 5 sites across the City (Figure 1). Electromagnetic-induction and natural gamma borehole geophysical logs also were collected at the 5 sites. Continuous 4-in-diameter cores were collected at these sites, as well as at two additional sites where wells were not installed (Figure 1). Approximately 1,700 feet of core were collected and boxed during drilling and are stored at the Virginia District Office of the USGS in Richmond.

Legislation for Public Water Supply Testing for MTBE

Methyl tertiary-butyl ether (MTBE) is a highly water-soluble gasoline additive that came into limited use in the 1980s as an octane booster. After passage of the U.S. Clean Air Act in 1990, MTBE became widely used as a gasoline oxygenate. MTBE is used in gasoline but is not used in most other petroleum products; consequently MTBE-contaminated water is generally associated only with gasoline spills. Because of concern that gasoline spills containing MTBE may be

impacting public drinking water, the 2000 General Assembly passed legislation that requires public water supply operators to test public water supplies for MTBE on a quarterly basis.

Under the legislation, a public water supply operator must maintain a record of the testing and, if the results of any test indicate the presence of MTBE in excess of 15 parts per billion, the operator must immediately notify the Department of Health

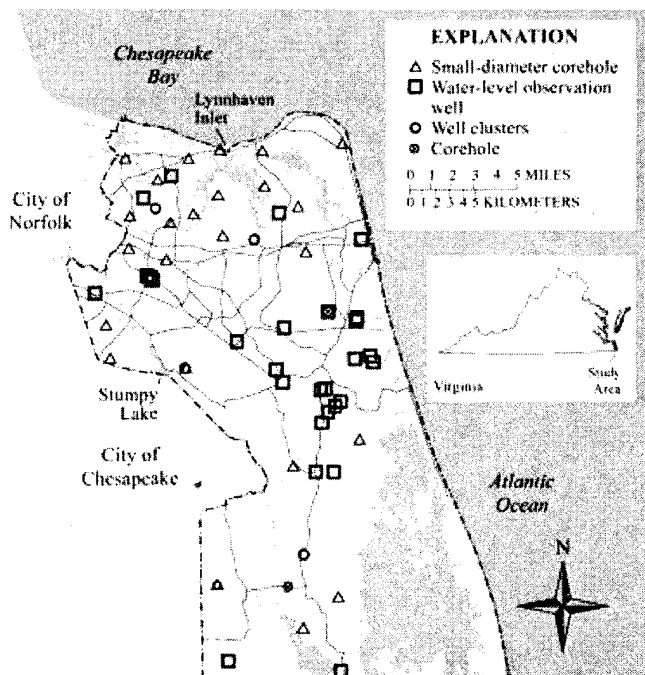
and the Department of Environmental Quality. The Department of Health will use this information to work with the operator to address the contamination in the drinking water. The Department of Environmental Quality will attempt to identify the source of contamination and, if necessary, require corrective action.

The legislation also requires the Division of Consolidated Laboratory Services (DCLS) to maintain and make available, upon request, a list of laboratories performing this testing. DCLS will establish a fee system to offset the public water supply costs of testing for MTBE and will also report to the Governor and the General Assembly by November 1, 2000, on the estimated costs and personnel requirements for administering the MTBE tests.

MTBE - Did You Know?

The 1990 Clean Air Act required areas exceeding certain levels of ozone to use Reformulated Gasoline. Reformulated Gasoline (RFG) contains oxygenates by weight. These oxygenates are intended to reduce levels of ozone emissions from vehicles. RFG can consist of many different types of chemicals. News stories in the summer of 2000 about high fuel prices in the mid-West often blamed those prices on RFG. Did you know that Virginia uses RFG as well? In the western states, the oxygenate is mostly ethanol alcohol, which is produced using corn and other crop wastes. The primary chemical constituent in Virginia's RFG is Methyl Tertiary Butyl Ether (MTBE). MTBE is produced during the distillation of crude oil and natural gas liquids. It is then mixed back with gasoline to produce RFG. This production method costs less than ethanol, so many oil companies support using MTBE over Ethanol.

In Virginia certain Non-Attainment areas of the State are required by the EPA to use RFG. *by Ian Waugh, Longwood College*



Virginia Agricultural Stewardship Act - April 1, 1999 to March 31, 2000 Update and July 1, 2000 Revisions

The Agricultural Stewardship Act is the result of a joint effort by Virginia's agricultural and environmental communities, the Association of Soil and Water Conservation Districts and state agencies to develop a common-sense solution to water pollution problems caused by agricultural operations. The goal of the Act is to consider the needs of the farmer while meeting the requirements of the environment.

The Virginia General Assembly passed the law in 1996, and when the Agricultural Stewardship program went into effect on April 1, 1997, it represented an innovative approach to environmental concerns.

Complaints alleging that a specific agricultural activity is causing or will cause water pollution go to the Commissioner of the Virginia Department of Agriculture and Consumer Services. If a complaint meets the criteria for investigation, the Commissioner's Office contacts the appropriate Soil and Water Conservation District about investigating the problem. If the district declines, the Commissioner's Office conducts the investigation.

The purpose of the investigation is to determine whether the agricultural activity is causing or will cause water pollution. If no causal link is found, the Commissioner will dismiss the complaint. If the investigation determines that the activity is the cause, the farmer is given sixty days to develop a corrective plan. The local District then reviews the plan and when it meets the necessary requirements to solve the water pollution problem, the Commissioner approves it.

From the time the Commissioner determines that a complaint is founded, the Act gives the farmer six months to start implementing his plan and up to eighteen months for full implementation. The timing allows the farmer to take advantage of suitable weather conditions for outside work or construction required. If a farmer fails to implement a plan within the eighteen-month time limit, the Act requires the Commissioner to take enforcement action.

In the third year of the Agricultural Stewardship program, the Commissioner received more than 90 inquiries regarding possible agricultural pollution, of which 29 became official complaints. Seven areas were the subject of this year's complaints: dairy - 7; beef - 6; poultry - 5; cropland - 4; hogs - 3; horses - 3; sheep - 1.

Program Objectives:

To identify real water quality problems and to help farmers correct them in a common-sense manner that accommodates both the farmer and the environment;

To establish a system that respects both the farmer and the person voicing concern about water quality;

To educate farmers about stewardship and to encourage them to enhance it even in instances in which a water quality problem cannot be proven in a legal sense;

To support farmers in their efforts to strengthen their stewardship practices, to provide them with the information they need, and to help link them to resources that can provide assistance;

To educate the average citizen about normal farming practices that are not harmful to water quality regardless of their appearance; and

To provide Soil and Water Conservation Districts with training and the Agricultural Stewardship Act materials they need, to the extent that resources will allow.

The Agricultural Stewardship Act addresses water pollution problems caused by nutrients, sediments and toxins entering state waters from agricultural activities. Eleven of the complaints involved both sediments and nutrients. Fourteen

complaints attributed the pollution problems solely to nutrients, while four faulted only sediments. Twenty-four of these complaints concerned surface water issues, two concerned ground water, and three involved both ground and surface water.

The Commissioner's Office, together

Types of Complaints By Percentage

Nutrients - 48%

Sediment and Nutrients - 38%

Sediment - 14%

with local Districts in many cases, completed investigations in 28 complaints. As of March 31, 2000, one complaint still awaited a decision by the Commissioner.

Investigations determined that 11 of the complaints revealed insufficient or no evidence of water pollution, therefore, these complaints were unfounded. In some of these cases, no clear connection could be made between the alleged pollution and the body of water in question. In other cases, the alleged problem had been corrected by the time the investigation was completed. In some instances, the farmers involved in unfounded complaints voluntarily incorporated best management practices into their operations to prevent more complaints or to prevent potential problems from developing into founded complaints.

In 17 of the investigations, there was sufficient evidence to support the allegations that the agricultural activities were causing or would cause water pollution. These cases were determined to be founded. Sixteen of the producers with founded complaints submitted plans that were reviewed by the local Soil and Water Conservation District and approved by the Commissioner. On March 31, the plan regarding the 17th complaint was in the development process.

Farmers involved in the complaint and correction process were very cooperative in meeting the deadlines set by the Agricultural Stewardship Act and it was not

necessary to assess any civil penalties.

Results of Complaints:

Founded - 59%

Unfounded - 38 %

Awaiting Decision by

Commissioner - 3%

Amendments to the Agricultural Stewardship Act

Experience gained from three years of administering the Agricultural Stewardship Act clarified the need to revise certain aspects of the Act to make it function more efficiently and more economically and to provide for a higher level of customer service. The 2000 General Assembly passed amendments that become effective July 1, 2000, which addressed several areas of concern: enforcement, appeals and the role of the soil and water conservation districts.

One important enforcement issue dealt with the Act's failure to require the farmer to maintain the improved practices stipulated by his implementation plan. This omission, potentially, could result in the recurrence of water quality problems. The revised Act states

that the owner or operator "shall maintain the stewardship measures established pursuant to the plan." Farmers may change their activities that are subject to the plan, so long as they notify the Commissioner.

Revisions also give the Commissioner of Agriculture discretion to choose the time when the farmer will be required to complete implementation of the stewardship plan. The decision will be based on when the weather and other seasonal factors provide the greatest possibility of success for plan requirements, but the farmer must complete implementation within eighteen months from receipt of notice.

Although the original Act gave the Commissioner power to issue a corrective order when a farmer failed to begin implementing his plan, it did not give him the same power if a farmer failed to complete implementation or maintain the plan practices. The only enforcement option was to turn the case over to the Attorney General, which usually had to pursue the lengthy and cumbersome process of obtaining a court order. The revised Act corrects those deficiencies by empowering the Commissioner to act directly.

Before the Commissioner can issue a corrective order, the original Act calls for a hearing. Amendments to the Act now substitute the Administrative Process Act's (APA) more relaxed informal fact-finding proceeding for a formal APA evidentiary hearing. The change reduces the time and expense caused by the more rigid procedure.

The revised Act clarifies the role of the local soil and water conservation districts by stating that only the Commissioner of Agriculture and Consumer Services is responsible for the types of determinations under the Act that could be the subject of lawsuits.

Continued from Agency Functions page 5

and the resulting pollution. Second, the Regulations require that all lands being actively farmed within Chesapeake Bay Preservation Areas must have a soil and water quality conservation plan approved for the land. Third, the Regulations require vegetated buffer areas 100 feet wide along all perennial streams. Fourth, CBLAD's program encourages site planning that minimizes impervious cover and conserves as much existing vegetative cover as is feasible. These practices are aimed at preventing and minimizing pollutant impacts from land development, some of which affect ground water. Finally, CBLAD is conducting a long term water quality monitoring project to determine whether the program's requirements are having their intended effect. This project includes a ground water monitoring component. (Web Site: <http://www.cblad.state.va.us>)

The Department of Conservation and Recreation (DCR) is committed to the protection and conservation of Virginia's ground water through implementation of strategies that are based on state ground water standards, and are addressed in the Virginia Nonpoint Source Pollution Management Program. (Web Site: http://www.state.va.us/~dcr/dcr_home.htm) Contact: Jody Aston, Water Quality Improvement Act program coordinator, 804-371-8984.

The Virginia Department of Health (VDH) is committed to the protection of Virginia's ground water via Code of Virginia Section 32.1 Article 2 Public Water Supplies through implementation of Virginia's Waterworks Regulations. The Code and Regulations establish authority and procedures for permitting and construction standards for ground water supplies in order to supply pure water to the citizens of the Commonwealth. (Web site: <http://www.vdh.state.va.us/>) Contact: Bob Hicks, 804-786-1750.

Continued on page 13



1999 VIRGINIA PLASTIC PESTICIDE CONTAINER RECYCLING PROGRAM FINAL REPORT

The Virginia Department of Agriculture and Consumer Services (VDACS), in cooperation with the Virginia Pesticide Control Board (PCB), continued the Plastic

Pesticide Container Recycling Program (PPCRP) in 1999. The program offers the agricultural community an environmentally responsible alternative for the disposal of properly rinsed plastic pesticide containers. In its seventh year of operation, the PPCRP

1999 program and agreed to participate in the 1999 program. In addition, Aquamix, Inc. requested to participate. The pesticide dealers participated by accumulating their own properly rinsed pesticide containers at their locations where they were scheduled for granulation.

VDACS executed a Memorandum of Agreement with each participating locality that detailed the responsibilities of each agency and provided for the reimbursement of up to \$1,875 in locality incurred expenditures for administering the Program. Localities were responsible for administering the program, including the purchase of equipment (box trucks, trailer, etc.) for the secure, dry storage of properly rinsed pesticide containers, inspecting containers for cleanliness, executing Certificates of Inspections (required by the Agricultural Container Research Council) and assisting at the time of granulation. VDACS was responsible for providing jet-rinse nozzles for distribution to participating farmers, training of local personnel in proper container inspection procedures, scheduling the granulator for visits to each site, and providing on-site supervision during the granulations. In all but one locality (Greensville County), VCE representatives coordinated the program with the local governments, promoted the program, educated growers as to proper pesticide container rinsing procedures, and assisted in the container inspections and granulations.

The program operated under the guidelines of the Agricultural Container Research Council (ACRC) which provided training materials and contractors for the disposal of the granulated plastic. The granulator contractor for 1999 was USAg Recycling, Inc., Pasadena, Texas. USAg Recycling stations a granulator in Lumberton, North Carolina to service Virginia and provided granulation services (chipping and bagging of the plastic containers and removal of the plastic chips) at no cost to Virginia.

Most container collection sites were set

up and began to operate during the spring and summer months of 1998. Some sites are operated year round by local governments. Collection sites were established at regional or county landfills, recycling centers, agricultural chemical dealers, and a county fairground. Containers were collected in trailers, cargo containers, warehouses and covered sheds. Collections were offered by appointment, on fixed dates, or during regular operating hours, depending on the local facilities and resources. Frederick and Clarke counties offered container pick-up services for area fruit growers.

USAg Recycling made 24 site visits in four trips, spending a total of 14 days in Virginia during July, September, October and November 1999. Almost 50,000 containers were accepted and granulated during the season. The majority of the containers were 2.5-gallon jugs. Approximately 1.5% of the containers were rejected by the granulator for improper rinsing. Local government personnel arranged for the safe disposal of any unacceptable containers.

The number of plastic pesticide containers collected and recycled during 1999 decreased by 9.1% from 1998, the second consecutive decrease in the number of pesticide containers recycled since the program's inception. The number of con-

Localities - 1999

City of Chesapeake
Northumberland Co.
Clarke Co.
Pulaski Co.
Dinwiddie Co.
Prince George Co.
Frederick Co.
Rockingham Co.
Grayson Co.
Southampton Co.
Greensville Co.
City of Suffolk
Isle of Wight Co.
City of Virginia Beach
New Kent Co.
Westmoreland Co.
Northampton Co.

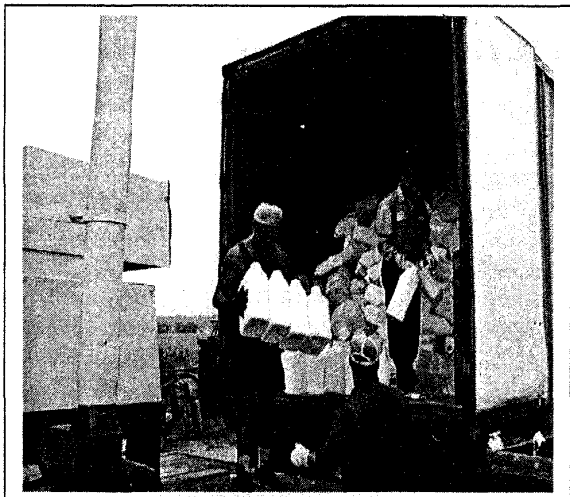
recycled approximately 50,000 plastic pesticide containers in seventeen localities and eleven pesticide dealer locations.

The 1999 Plastic Pesticide Container Recycling Program was offered to all Virginia localities. The Chemical, Drug and Pesticide Unit of VPI&SU assisted in disseminating information on the availability of the Program through their electronic mail system to local VCE agents. All localities that participated in the 1998 Program except Lancaster and Northumberland counties applied for the 1999 Program. In addition, Grayson and Pulaski counties applied for participation. Lancaster and Northumberland counties did not participate in the 1999 program due to the loss of the VCE agent managing the local program in these two counties.

The pesticide dealers who participated in the 1998 program were advised of the

Pesticide Dealers - 1999

Aquamix - Botetourt Co.
Plant Food Products - City of Hopewell
Royster Clark - Essex Co.
Alliance Agronomics - Richmond Co.
Royster Clark - City of Chesapeake
Royster Clark - Westmoreland Co.
Royster Clark - Northampton Co.
Royster Clark - King George Co.
Southern States - King William Co.
Royster Clark - King William Co.
Timberland Ent. - Chesterfield Co.



containers recycled in participating localities ranged from none (Pulaski, Grayson and Westmoreland counties) to 14,163 (Southampton County). Pesticide dealers recycled 14,774 containers representing approximately 30% of the total number of containers recycled. The greatest number of pesticide containers recycled were in the peanut production areas of Virginia (Southampton and Dinwiddie counties).

The general decline in containers recycled was attributed to the increased availability and use of bulk containers, particularly Roundup® for use with Roundup Ready® soybeans. In addition, the flooding in southeastern Virginia associated with two hurricanes caused the loss of many pesticide containers collected for recycling at the City of Suffolk recycling site.

The variability of pesticide containers collected by participating localities may be a function of how the program is administered by the locality. Local program administration varies from local government personnel visiting agricultural producers to inspect and transport the inspected containers to the established collection site, using local landfills and training landfill employees as inspectors, requiring growers to set up appointments for delivering containers to the collection site or establishing times when the collection site would be open for delivery of containers by growers.

The number of containers recycled at participating pesticide dealer sites decreased from 15,120 in 1998 to 14,774 in

1999 (2.3%). The decrease was again mainly due to an increase in the use of bulk packaging. A new participant in the 1999 program was Aquamix, Inc. Aquamix employs a closed container system for delivery and transfer of herbicides to spray application equipment. The reusable, refillable 15 and 30-gallon containers used to transport the herbicides to the end user were offered for recycling this year for the first time.

VDACS will continue this program in 2000 with a continued effort to increase the number of pesticide dealers participating in the program.

Continued from Committee 99-00, page 1

education of ground water users so that they can differentiate between real threats and false alarms in order to protect their water, and greater awareness in general of ground water and the need for its protection.

Each expressed support for continuing the Steering Committee as a vehicle for information exchange among agency members. But each indicated some regret that the Steering Committee could not play a greater coordinating role in identifying and resolving ground water problems, a limitation inherent to the way that programs are currently enacted and funded. Both men observe that ground water protection is enhanced by attention to ground water from elected leaders and agency heads.

Mr. Bartsch and Mr. Lefebvre will be missed for their experience, expertise, and professionalism, and most especially for their good nature. While these two will not soon be forgotten, Steering Committee members look forward to working with new representatives from their respective agencies.

Bi-monthly Steering Committee meetings during 1999-2000 again saw a variety of educational presentations. These included a demonstration of the interactive educational CD-ROM on the geology of

Virginia (see article on p. 6), an update on the Nonpoint Source Management Program (see p. 5), and a presentation about Virginia Naturally 2000, an environmental education initiative first announced by Governor Gilmore in his Commonwealth address earlier this year (see p. 4).

Other presentations included the following:

- ◆ A demonstration of the Petroleum Storage Tank Mapping & Reference System (PST MRS) by Herb Ward of DEQ's Office of Spill Response and Remediation. PST MRS is an interactive Geographic Information System (GIS) program that provides citizens of Virginia with an easy means of locating petroleum release sites. Users simply click on the county in which they are interested. The second screen has an interactive map where the user can zoom in on a specific area. Reports of specific sites can be obtained by pointing and clicking.

- ◆ An overview of the first Ground Water Report to Congress of the Safe Drinking Water Act. The Report, which was put together by a working group including EPA staff and state program officers over a period of 18 months, covers much of the same points and issues addressed by Ground Water Protection Steering Committee over the years. The Report includes extensive lists of resources, references, and an appendix that details state ground water conditions. There are references to the issues of water quantity, the link between surface and ground water, and ground water contribution to nonpoint source contamination. The full Report may be found on the web at <http://www.epa.gov/ogwdw>.

- ◆ Summary reports of the 2000 Virginia General Assembly's legislative initiatives affecting ground water.

Steering Committee meetings are held on a bi-monthly basis from 9 a.m. to 12 a.m. on the third Tuesday of the months. For information call Mary Ann Massie, Department of Environmental Quality, 804-698-4042.

1999 Virginia Pesticide Disposal Program

The Virginia Department of Agriculture and Consumer Services (VDACS) in cooperation with the Virginia Pesticide Control Board (PCB) implemented its 9th Pesticide Disposal Program in 1999 in the following 33 Virginia localities:

Accomack	Newport News
Charles City	Norfolk
Chesapeake	Northampton
Chesterfield	Petersburg
Colonial Heights	Poquoson
Dinwiddie	Portsmouth
Emporia	Powhatan
Franklin	Prince George
Goochland	Richmond City
Greensville	Southampton
Hampton	Suffolk
Hanover	Surry
Henrico	Sussex
Hopewell	Virginia Beach
Isle of Wight	Williamsburg
James City	York
New Kent	

The 1999 program was significant because it was the first time that Virginia localities had been visited a second time for the collection of unwanted, outdated and banned pesticides.

Following culmination of the 1998 program, which completed the initial collection of unwanted or outdated and banned pesticides in all Virginia localities, the Virginia Department of Agriculture and Consumer Services (VDACS) conducted surveys of all Virginia Cooperative Extension (VCE) agents to determine the need to continue the program. More than 95% of the agents indicated that the program should be continued.

In addition, over 400 past participants in the pesticide disposal program were contacted to determine their satisfaction level with the program and whether they anticipated having pesticides requiring disposal in the future. Ninety per cent indicated a high satisfaction level with the program and almost 50 per cent stated that they anticipated having pesticides

requiring disposal in the future.

Based on this data, the Virginia Pesticide Control Board decided to continue the pesticide disposal program for an additional four years from 1999-2002. To implement the program, the Commonwealth was subdivided into four regions with each region participating on an annual basis.

VCE provided significant assistance in the survey and collection phases of the program. VCE was responsible for contacting and surveying agricultural producers within their respective localities.

VDACS and VCE publicized the program through newsletters, newspaper articles and radio broadcasts to generate additional participation. Each identified participant was visited by either the local VCE agent or VDACS Pesticide Investigator to verify quantities for disposal.

The Division of Consolidated Laboratory Services (DCLS) provided laboratory analysis of unknown materials. Only those unknowns that were greater than either 50 pounds for solid material or 5 gallons for liquid material were sampled by VDACS. Unknowns below the threshold were analyzed in the field by the disposal contractor for manifesting purposes.

The collection phase of the program began on September 13, 1999 and was completed on September 24, 1999. A total of 97,618 pounds of pesticide waste was col-

lected from 149 agricultural producers, pesticide dealers and pest control firms. Several localities, mainly independent cities, did not have any pesticides requiring disposal. A breakdown of the quantities of pesticides collected for disposal from each locality is in Table 1.

The total cost of the 1999 program was \$116,149.80

In the majority (19/26) of participating localities, the quantity of pesticide waste collected during the 1999 program was less than collected during the first collection. This was anticipated. The decrease in pesticide waste collected also did not ap-



pear to depend upon the length of time between collections. The one factor that was apparent was the direct impact VCE had on the participation and the amount of pesticide waste collected.

The maintenance phase of the program will continue through 2002 when all Virginia localities will have participated twice in the program.

Funding for the Virginia Groundwater Protection Steering Committee activities, including development of this report, is provided through a grant to the Department of Environmental Quality by the US Environmental Protection Agency

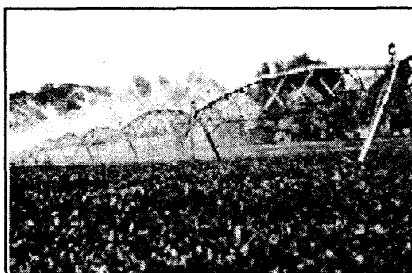
Virginia Cooperative Extension - Irrigation Management Educational Program

During 1999-2000, Virginia Cooperative Extension conducted an educational program designed to improve irrigation management skills in order to protect Virginia's surface and ground water resources through the voluntary adoption of best management practices as identified in Virginia's Coastal Nonpoint Source Pollution Control Program. To support this aim, two publications on irrigation management were developed: (1) a brochure defining irrigation management issues and BMP implementation and (2) a more detailed, site-specific evaluation procedure published in the Virginia Farmstead Assessment System (Farm*A*Syst) format as a separate chapter on irrigation management. In addition to other readily available publications, they were compiled into an irrigation management training notebook. Major themes addressed were (1) irrigation practices and their effect on surface and ground water quality, (2) irrigation water management principles and techniques, (3) safe and efficient chemigation practices, and (4) additional irrigation BMP considerations.

The notebook, in turn, served as supporting material for a series of 1-day irrigation management workshops presented at three locations in Eastern Virginia, Exmore, Wakefield, and Tappahannock. Speakers from Virginia Cooperative Extension, Virginia Tech, VDCR, VDEQ, and NRCS participated in the training. More than 100 irrigators pre-registered for the workshops and a total of 83 completed the workshop training.

The results of a post-workshop evaluation indicated that participants were satisfied with the program effort and that they highly understood the link between proper irrigation management and environmental protection. Additionally, the vast majority of respondents found the Virginia Farm*A*Syst approach to irrigation management to be a positive exercise.

Funding support for this educational effort was provided by the Virginia Department of Conservation and Recreation in coordination with the Virginia Coastal Resources Management Program at the Department of Environmental Quality through a grant from the National Oceanic and Atmospheric Administration, Office of Ocean and Coastal Resource Management.



For more information contact Blake Ross, Professor and Extension Agricultural Engineer, Department of Biological Systems Engineering, Virginia Tech, Blacksburg, VA 24061-0303; or Randy Shank, Virginia Cooperative Extension/VDCR-DSWC Water Quality Education Coordinator, 203 Governor St., Suite 206, Richmond, VA 23219.

Continued from Agency Functions page 9

The Department of Environmental Quality (DEQ), Committee Chair -

Ground water programs in Virginia strive to maintain existing high water quality through adopted statutes, regulations, and policies. Advancing ground water protection efforts is the goal of many DEQ programs including ground water withdrawal permitting, ground water protection, construction assistance, tank compliance, and waste permitting.

The ground water/corrective action staff within the Office of Waste Permitting reviews ground water quality data from all solid waste facilities (landfills) and all land-based hazardous waste facilities (landfills, land treatment units, waste piles, and surface impoundments). The staff ensures that the facilities are in compliance with the regulations and completes all the ground water permitting requirements for those facilities. The staff is also involved with the closures of land-based hazardous waste units for the ground water issues. (Web Site: <http://www.deq.state.va.us>) Ground Water Protection contact: Mary Ann Massie, 804-698-4042. Waste Management Issues contact: Howard Freeland, 804-698-4219

The Department of Mines, Minerals and Energy (DMME) protects and

conserves Virginia's ground water by providing for the safe and environmentally sound development of mineral resources by regulating the mineral extraction industry, providing geologic field investigations, and offering technical assistance on the wise use of mineral and energy resources. Four of DMME's six divisions administer programs with ground water implications: Gas and Oil addresses development of gas, oil, and geothermal resources; Mined Land Reclamation ensures reclamation of land affected by surface and underground coal mining activities; Mineral Mining ensures reclamation of lands affected by mining of nonfuel minerals; and Mineral Resources pro

Continued on page 16

Better Site Design and the Chesapeake Bay Preservation Act

Under the authority of the Chesapeake Bay Preservation Act, the Chesapeake Bay Local Assistance Department (CBLAD) exists to protect the Chesapeake Bay and other waters of the Commonwealth from the impacts of pollution associated with the use and development of land. The development of land alters the land surface by replacing natural cover and native vegetation with impervious surfaces, such as rooftops, roads, parking lots, driveways, and sidewalks. The increased impervious cover resulting from development can alter the hydrology of a watershed by preventing infiltration of stormwater into soil and thus resulting in decreased ground water recharge. Modifying the hydrology in this way may also result in an increase in the frequency and volume of stormwater runoff and its associated pollutants. Additionally, the land disturbance and subsequent erosion that occur during development can result in excessive sedimentation in water bodies.

The Bay Act requires Tidewater localities to designate certain sensitive lands as Chesapeake Bay Preservation Areas (CBPAs). Development is permitted in some of these areas, but must meet eleven performance criteria established in the Chesapeake Bay Preservation Area Designation and Management Regulations. Three of these eleven performance criteria are more subjective than the others but can be met through better site design. These three general performance criteria are minimizing land disturbance, minimizing impervious cover and preserving indigenous vegetation.

In 1999, CBLAD collaborated with the Center for Watershed Protection (CWP) to develop the publication, *Better Site Design: An Assessment of the Better Site Design Principles for Communities Implementing Virginia's Chesapeake Bay Preservation Act*, which was completed in early 2000. The publication identifies and describes sixteen model development principles that promote the implementation of the three general performance criteria. The sixteen principles were selected from the twenty-two model development principles

identified in CWP's publication, *Better Site Design - A Handbook for Changing Development Rules in Your Community*. The CBLAD publication also presents four case studies where the sixteen principles were applied in development projects in Virginia.

Each of the model development principles falls into the area of conservation of natural areas, lot development, or residential streets and parking lots. Not all sixteen principles will apply in all development situations, as evidenced by the case studies in the publication. However, it is important to consider the principles early in the site planning and review process and to apply those principles that are most appropriate to the development situation. In addition to promoting environmentally sensitive, economically viable, and locally appropriate development, the model development principles are designed to be used by planners, developers and local officials as benchmarks to investigate where existing ordinances can be modified to address the three general performance criteria.

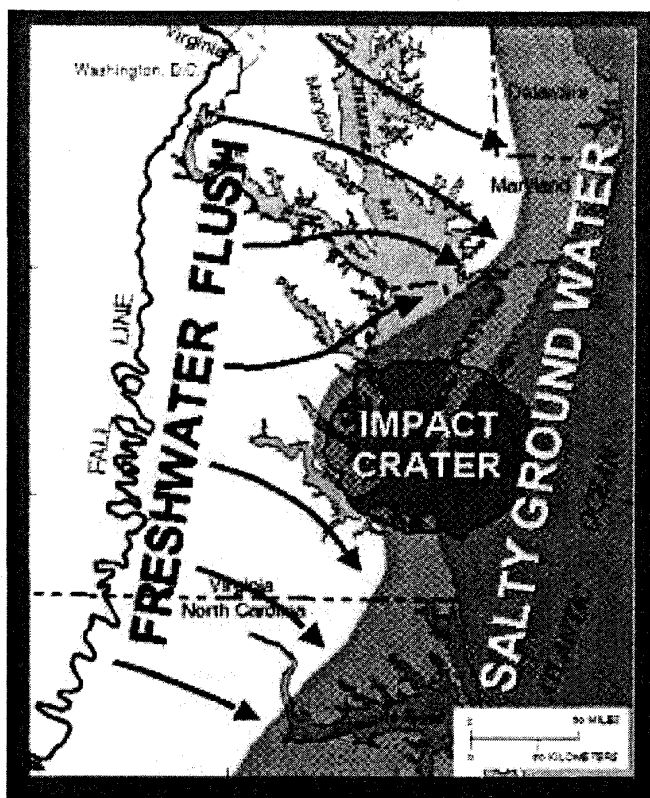
The key to success for incorporating the three general performance criteria into development plans is to incorporate them at the beginning of the site design process, rather than at the end. Therefore, the first step in site design should be the identifica-

tion and preservation of sensitive features, such as steep slopes, non-Resource Protection Area (RPA) wetlands, intermittent streams, stands of mature forests, and ground water recharge areas. Once areas suitable for development have been determined, the design process should then focus on how to meet the needs of the proposed development within these areas. This phase of site design includes laying out lots and locating and sizing structures such as roads, driveways and parking areas.

In 1999-2000 CBLAD sponsored several workshops in Tidewater Virginia in order to present the better site design concept and the model development principles to Bay Act stakeholders, who include local government staff, developers, design professionals, and local policymakers. Through these workshops, CBLAD also hopes to identify possible impediments to implementing the model development principles. CBLAD's goal in doing so is to refine the principles so that they are easier to implement and to explore ways to overcome roadblocks to implementation.

For more information about better site design and the Chesapeake Bay Preservation Act, please contact the Chesapeake Bay Local Assistance Department at 1-800-CHES-BAY or at www.cblad.state.va.us.





Continued from *Ancient Blast* page 1

of years. During the next several million years, additional layers of sediment were laid down to cover over the crater. Sea level resumed its pattern of rise and fall—but now with a difference. Settling of this jarred section of the earth's crust continued, faulting and deforming the sediment layers over the crater. Subsidence of the land surface likely caused the alignment of the region's rivers and streams that we see today, possibly even resulting in the formation of Chesapeake Bay. Small magnitude earthquakes are still recorded in the region as the crust continues to adjust.

The impact also left lasting effects on eastern Virginia's ground-water resources. Rapidly developing areas such as Newport News rely heavily on ground-water supplies because all of the large surface-water bodies nearby are brackish estuaries. The normal sequence of sediment layers that make up Virginia's Coastal Plain aquifer system, however, was intensely disrupted by the blast. Hence, a complex array of broken-up sediments now fills the crater. Just as the courses of rivers and streams

along most coastal areas is normally salty, especially in deep aquifers where dense saltwater lies beneath shallower fresh ground water. Salty ground water in Virginia, however, extends far inland of the normal position (see figure). Hence, the availability of fresh ground water has been constrained, and some localities have had to undertake costly desalinization treatment.

The relation of the crater to the saltwater wedge, however, is not entirely clear. Because the ocean covered the area during the impact, the aquifers were probably filled with saltwater at the time. The ocean receded about 100,000 years ago though, and fresh water from rainfall has since been flushing out the saltwater from most of the aquifers. Under normal conditions, the aquifers would by now have been flushed out about ten times. To explain the wedge, a "differential flushing" hypothesis has been proposed in which old salty water may remain trapped within the crater-fill sediment, and the freshwater flush diverted to either side (see figure).

Other explanations have also been of-

need to be known to understand surface-water resources, the layering of these sedimentary aquifers must be known to understand how ground water is stored and transmitted through the region. Such information is critical for effective planning and management of the resource.

In addition to the *amount* of ground water available, the *quality* may be at stake. The crater coincides closely with an unusual region of salty ground water called the inland saltwater "wedge." Ground water

needed to account for salty ground water within the wedge. Deeply buried evaporite minerals could be dissolving into the ground water, or clay-rich sediments could be causing chemical "reverse osmosis" filtering of the water. Much information on ground water conditions in and around the crater still needs to be gathered before any of these explanations can be adequately tested.

If and how the crater caused the saltwater wedge may also be more than just an academic question. During the past century, large ground water withdrawals in the region have greatly altered the directions of flow that prevailed during the period of flushing. Understanding how the flushing happened is also needed to tell whether continued pumping may now draw in more fresh ground water and enhance flushing or—conversely—cause the spread of salty ground water and worsen the problem.

Planned drilling and other research during the coming years are aimed at gathering the information needed to better understand the formation of the Chesapeake Bay Impact Crater, its role in the geologic history of eastern Virginia, and its effects on the ground-water resource. Greater detail on the layering, faulting, and hydraulic properties of sediments in and around the crater is needed for a better picture of how the aquifers are interconnected. Chemical data are being sought that can identify the source of the salt and tell how long ground water has remained in these sediments. How the crater could have altered freshwater flushing—and could now be interfering with pumping—can be analyzed using a computerized ground-water flow model.

Ground Water Protection Steering Committee Website

Do you want to learn more about the Steering Committee's work? Or find web sites with ground water information. Let us know what you think of the site while you're there!

<http://www.deq.state.va.us/gwpsc>

Continued from *Local Committees* page 2
Shore. They then were able to obtain federal matching funding to support this effort. The end result of this effort was the publication of a report entitled "Ground Water Supply Protection and Management Plan for the Eastern Shore of Virginia." The information generated in this study has been the basis for recommended local ordinances to protect ground water on the Eastern Shore.

If you are interested in more information regarding local ground water protection efforts or in establishing a local ground water protection committee please contact Terry Wagner of DEQ at (804) 698-4043.

Continued from *Scientists* page 3

crater. The USGS Geologic Division, USGS Water Resources Division, the DEQ, and the Hampton Roads Planning District Commission will jointly sponsor this CBIC research project. The results of this research project will contribute one important component to a refined hydrogeologic framework for the Virginia Coastal Plain. For additional information regarding the CBIC contact Scott Bruce at (804) 698-4041 or see <http://geology.er.usgs.gov/eespteam/crater/>.

Continued from *Agency Functions* page 13

vides field investigations and information on the Commonwealth's mineral resources, including geologic mapping. Web Site: <http://www.mme.state.va.us> Contact: Lynn D. Haynes, 540-523-8179

The U.S. Geological Survey, Water Resources Division Virginia District (USGS) provides the hydrologic information and understanding needed for the optimum use and management of the Commonwealth's water resources. In cooperation with local, State, and Federal agencies, hydrologic information is collected and interpreted using a wide variety of techniques, and is transferred to the water-resource community through reports, maps, computerized information services, and other

forms of public releases. *Ground Water Protection*. (Virginia District's web site: <http://www.va.usgs.gov>; Bureau-wide web site: <http://www.usgs.gov>). Contact: Randy McFarland, 804-278-4750, ext. 267.

Virginia Cooperative Extension (VCE) provides educational programs on protection and use of Virginia's groundwater resources. A major component of the protection program deals with protection from pollutants such as pesticides and fertilizers. Extension agents in each political jurisdiction provide the educational programs. In addition, VCE's domestic water supply program has provided testing and evaluation of groundwater supplies for households in 40 rural counties. Corrective actions are recommended where supplies are found to be at risk. (Web site: <http://www.ext.vt.edu>) Contact: Waldon Kerns, 540-231-5995

The Virginia Department of Business Assistance (VDBA) is the economic development agency devoted to the growth and success of the Commonwealth's businesses, many of which rely on a sufficiency of quality ground water. As the primary point of communication and contact between Virginia's business community and state government the VDBA is uniquely positioned to provide accurate input regarding the probable impact of proposed regulations on our corporate citizens. (Web Site: <http://www.dba.state.va.us>) Contact: Dean Bailey, 804-371-8228

Dept. of General Services, Div. of Consolidated Laboratory Services (DCLS) consolidated laboratory provides analytical testing services to the Commonwealth of Virginia and other states as requested through state and federal agencies. DCLS services include certification services as required through the Safe Drinking Water Act. In addition to routine testing, DCLS may be called on to respond to various health and environmental emergencies in Virginia. (Web Site: <http://www.dgs.state.va.us/DCLS/index.htm>) Contact: Tom York, 804-692-0512.

PUBLICATIONS

A Demonstration of "Conjunctive" Source Water Assessments in Karst Areas – DCR, Terri Brown. The report will be made available to the participating waterworks, Virginia Department of Health headquarters (804-786-5568) and Field Office(s), and the Dept. of Conservation and Recreation.

The winter 2000 special edition of *Virginia Explorer Magazine* is a publication of the Virginia Museum of Natural History. This edition, "Virginia's Water Resources," highlights the Commonwealth's extraordinary water resources and details the state programs designed to protect and enhance water quality. The magazine is written for the eighth grade level; however it is appropriate for all ages. It includes breathtaking photographs, statistical charts, and maps that complement the detailed information on DEQ's water programs. DEQ hopes that readers will be well-informed and inspired to join the Department of Environmental Quality in their effort to protect Virginia's natural resources through volunteer and stewardship activities.

For copies, e-mail or send a sase to: Marcy Judd, Environmental Education #220, DEQ, 629 E. Main

Street, Richmond, VA 23219.

Better Site Design: An Assessment of the Better Site Design Principles for Communities Implementing Virginia's Chesapeake Bay Preservation Act. (A 60 plus-page publication that includes case studies.) Available on the web at www.cblad.state.va.us.

Better Site Design: An Informational Brochure for Virginia Communities Implementing the Chesapeake Bay Preservation Act. (An 8-page informational brochure.) Available on the web at www.cblad.state.va.us or in hard copy by contacting the Chesapeake Bay Local Assistance Department at 1-800-CHESBAY.

Virginia's Bay Act Program. (A 4-page informational brochure.) Available in hard copy by contacting the Chesapeake Bay Local Assistance Department at 1-800-CHESBAY.

The effects of the Chesapeake Bay impact crater on the geologic framework and the correlation of hydrogeologic units of southeastern Virginia, south of the James River: U.S. Geological Survey Professional Paper 1622. Available on the web at <http://usgs-georef.cos.com/>.